Ministry of Higher Education
& Scientific Research
Al-Muthanna University
Faculty of Pharmacy

وزارة التعليم العالي والبحث العلمي
جامعة المثنى
كلية الصيدلة

First stage

Faculty of Pharmacy

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Theory Histology

Lec. (1)

Dr. Ahmed Adeeb Mohamed Al-Tamimi

Circulatory system

The Circulatory system is categorized as:

1-Blood vascular system; consist of: A- Heart B- Vessels: (arteries, veins, capillaries)

2-Lymphatic vascular system; consist of: a- lymph vessels b- Organs

Circulatory system can be divided into:

General structure of Blood vessels (BV)

Blood vessels have 3 basic types of tissues:

- Endothelium also called endotheliocytes.
- Smooth muscle cells.
- Connective tissue.

General structure of BV: generally, each BV is composed of 3 layers (tunica = coat); these are from inside to outside:

1- **Tunica intima(TI)** subdivided into:

a- Endothelium (simple seq. epith.) .

b- Subendothelium: loose CT contain occasional smooth muscle cells.

c- Internal elastic lamina: composed of elastin that has gaps (for diffusion of substances to nourish cells deep in the vessel wall).In arteries may have a slightly folded.

2- **Tunica media(TM)**: composed of:

a- Concentric layers of helically arranged smooth muscle cells.

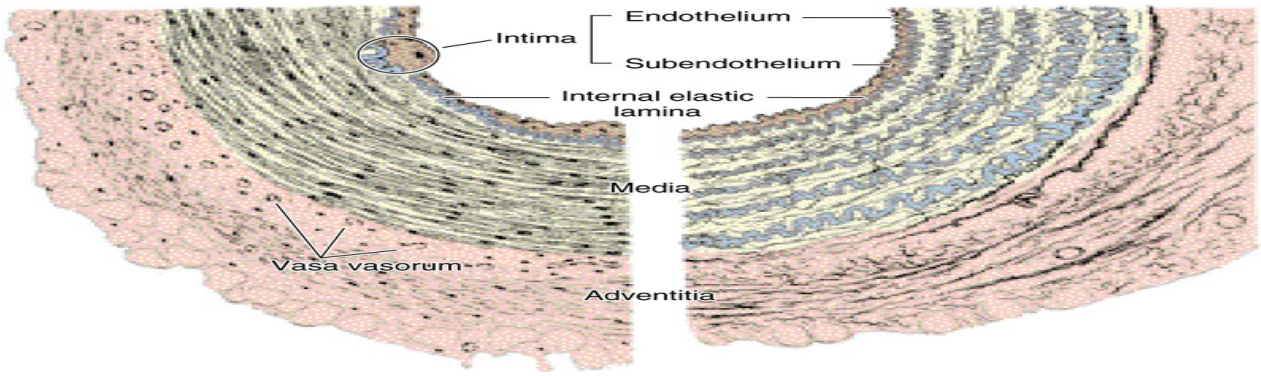
b- Elastic fibers & lamellae interspired between smooth cells.

c- Reticular fibers and Fibroblast and Ground substance

d- External elastic lamina.

e- In arteries, TM has a thinner external elastic lamina that separate it from TA.

3- **Tunica adventitia (TA)**: This coat consists of loose connective tissue in which collagen fibres are prominent. This layer prevents undue stretching or distension of the artery.



Classification of arteries

1- **Large size artery (elastic artery)**
2- **Medium size artery(muscular artery) and small size artery**
3- **Arterioles**

In arteries, **TM** is usually the thickest layer, while in veins; **TA** is commonly the thickest layer.

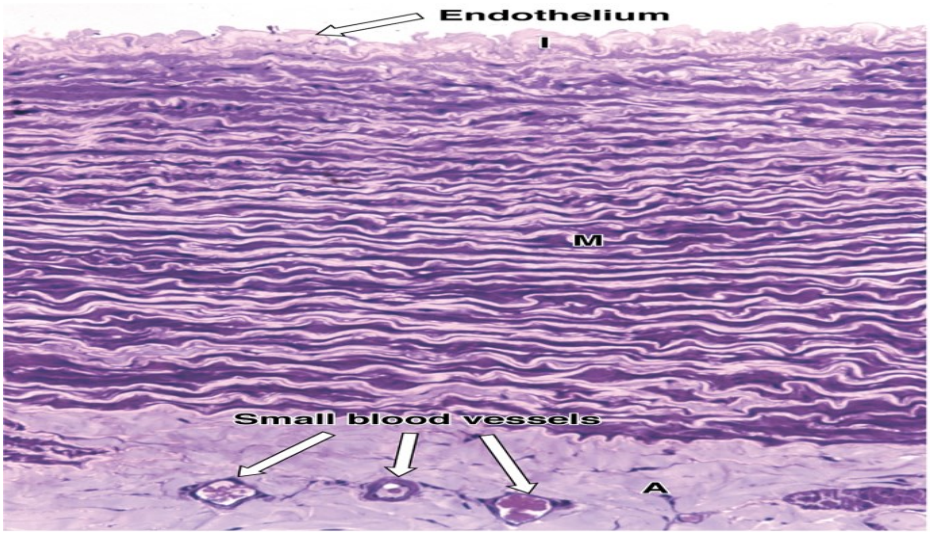
Large size a (elastic a, conducting a) **> 1cm diameter**

Include the aorta and the large arteries supplying the head and neck (carotids) and limbs (subclavian, axillary, iliac) & has yellowish color from the accumulation of elastin in the media.

Tunica intima: relatively well developed lined by polygonal endothelial cells. The subendothelial CT is fibroelastic .The internal elastic membrane is present but difficult to be diagnosed because it is usually mixed with the elastic lamina of TM.

Tunica media: it is the thickest layer in this type of arteries. Characterized by a distinct elastic lamella (40 in the newborn & 70 in adult in no., usually increase with age arranged in a concentrical pattern. Interspaces between the elastic laminae are occupied by fibroblasts, amorphous ground substance, collagen fibrils, fine elastic network and smooth m. cells.

Tunica adventitia: Loose c.t. , external elastic lamina present but can not be diagnosed because it is mixed with elastic lamina of TM.(thinner than TM)



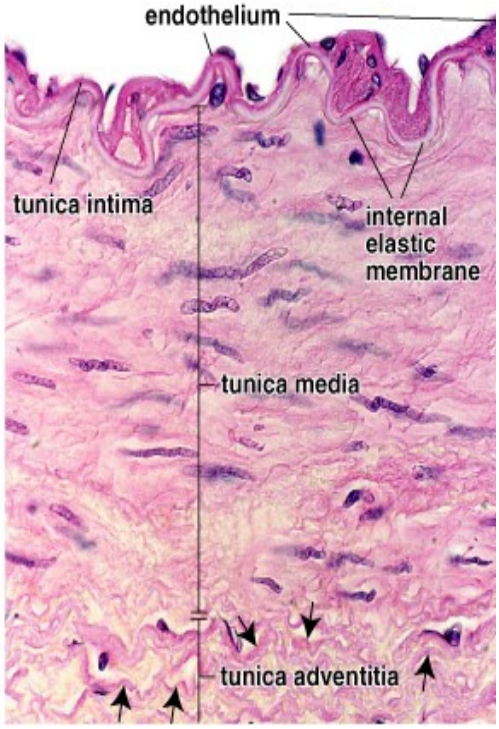
Medium (Muscular artery)and small size a(Distributing a)

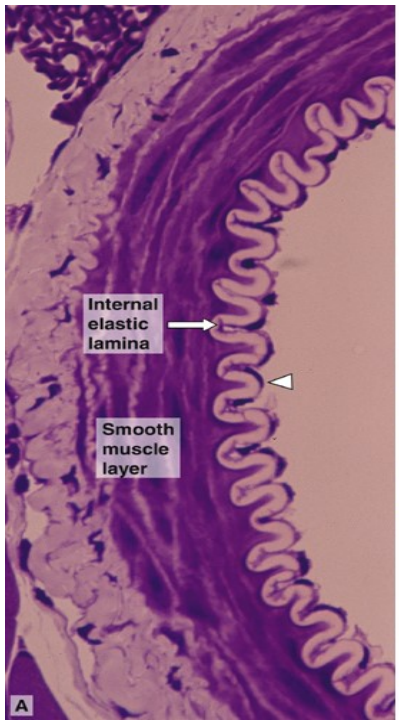
Characterized by thick wall and narrow lumen, when compared with elastic artery.

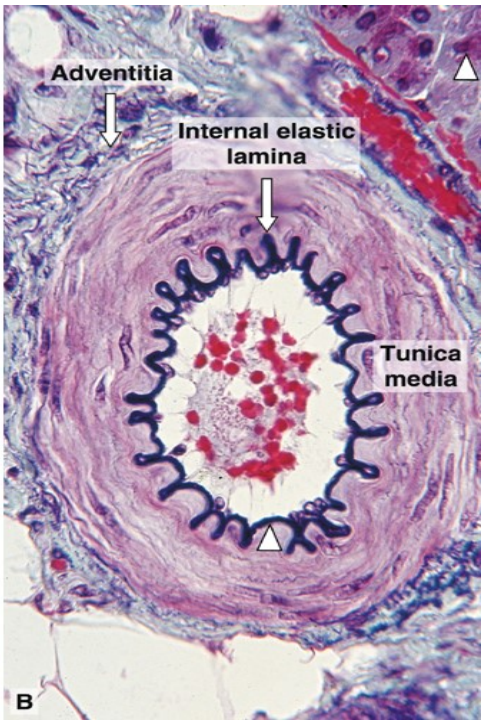
TI: have endothelium & a subendothelial layer that is somewhat thicker than that of the arterioles & prominent thick internal elastic lamina.

TM: Consist of 40 layers of circularly arranged smooth muscle fibers. Between smooth muscle fibers, there are small amount of CT that contains elastic lamellae and collagen fibrils, reticular fibers & few fibroblasts & external elastic lamina is prominent.

TA: Loose c.t. & composed of many layers in the larger muscular arteries & found lymphatic capillaries, vasavasorum , nerves & may penetrate to the outer part of the media. (thinner than TM)







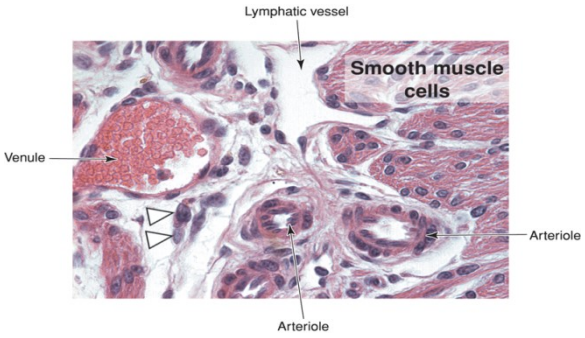
Arterioles (generally less than 0.5mm in diameter)

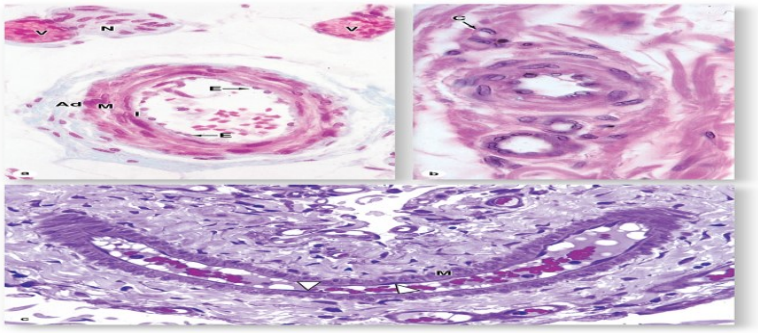
Have relatively thick wall & narrow lumen (when compared with venule).

TI: this layer is very thin; there is no recognizable & internal elastic laminae present in big arterioles only.

TM: composed of 1-5 layers of circularly arranged smooth muscle fibers among which scattered elastic fibers present.

TA: very thin fibro-elastic coat & has no external elastic membrane.





Arterial capillary (Precapillary) (metarteriole)

These vessels are located on the arterial side of the capillary bed & are larger than largest capillaries 12μ but less than 40 μ in diameter.

T I: composed of endothelium only.

TM: circularly oriented scattered smooth m. fibers.

	Elastic artery	Muscular artery
1-diameter of lumen	Wider	narrower
2-thickness of the wall	Thinner	Thicker
3-TM mainly consist of	40-70 elastic lamina	40 layers of smooth m. fibers
4- Int.&ext. elastic membrane	Cannot be easily diagnosed	Very prominent & diagnose easily
5-T I is	Thicker	thinner
6-TA is	It is relatively thin with greater proportion of elastic fibres.	It consists of thin layer of fibroelastic tissue.
7- example	Aorta & its large branches	Coronary artery

Capillaries

Act to permit different level of metabolic exchange between bloods & surrounding tissues.

Structure of capillary:

LM: transverse section of cap. contains (1-3) polygonal endothelial cells(TI) , whose nuclei bulge into the capillary lumen.

Classification of capillaries

Capillaries are classified according to their ultrastructure into:

1-continuous or somatic cap. (muscle tissue, lung, CNS, skin, CT, exocrine gland)

2- fenestrated or visceral cap. (intestinal mucosa, endocrine glands, renal glomerulus, and pancreas & choroids plexus).

3- sinusoidal (or discontinuous) cap. (liver & haemopoietic organs)

Classification of veins

- ***Venules***
- ***Small to medium size v.s***
- ***Large size v.s***

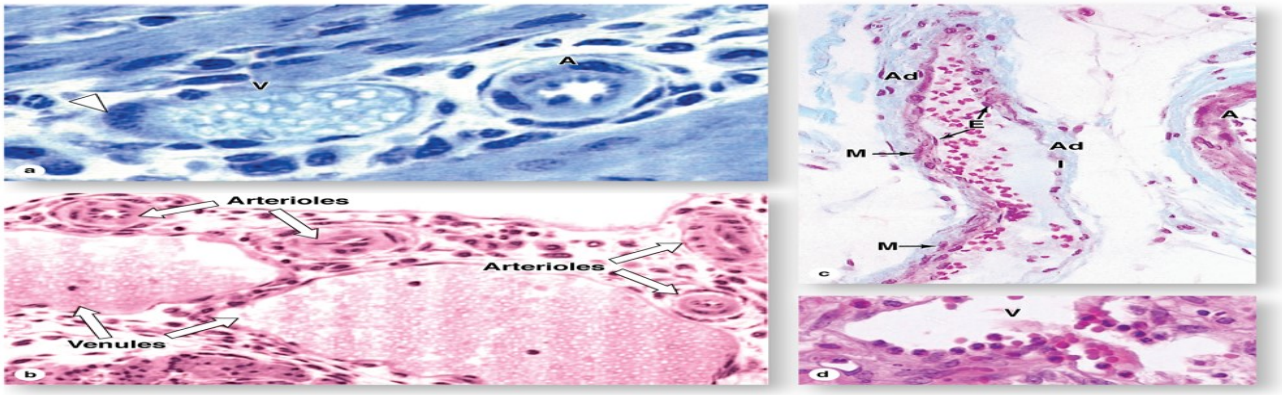
Venules

- Most venules are muscular.

-The smallest venule (40µm in diameter) **(a)** has **TI** that process endothelium with basal lamina. **TA**: outer thin sheath of collagenous fibers.

- In venules of 50µm diameter(**collecting v**) **(b)** smooth muscle fibers appear between endothelium & CT (i.e. **TM** appears).

- In 200µm diameter venule (**muscular v**) **(c)**; the circular muscle fibers form a continuous layer (**TM**), 2-3 cells thick. **TA** is thick & consists of longitudinally oriented collagenous fibers, scattered elastic fibers & fibroblast.



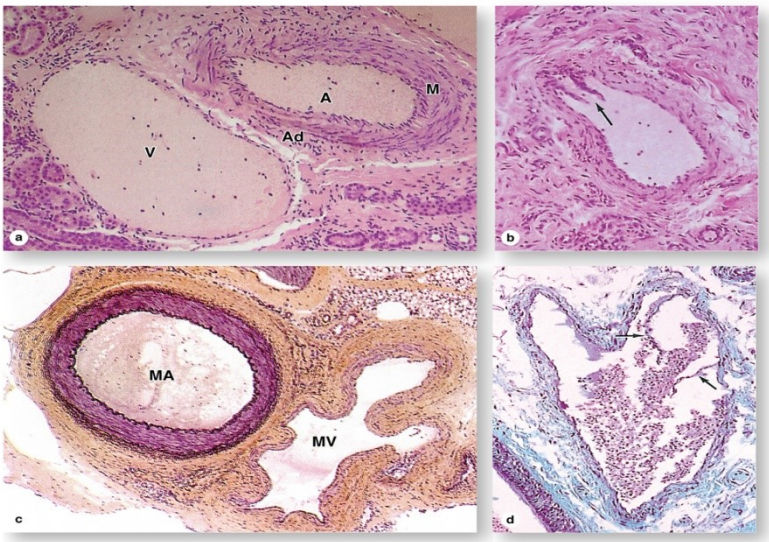
Small (a,b)**&medium**(c,d) **size**(MV) **v.s**

- diameter ranges 1-9 mm

- **TI** has no elastic membrane usually has a thin subendothelial which may be absent at times.

- **TM** thin & its best developed in venus of lower limb with few smooth muscle cells & intermixed with reticular & elastic fibers & abundant CT.

- **TA** thickest layer & there is thick longitudinal collagenous bundles & frequently few smooth muscle fibers which are arranged longitudinally along the vessels.



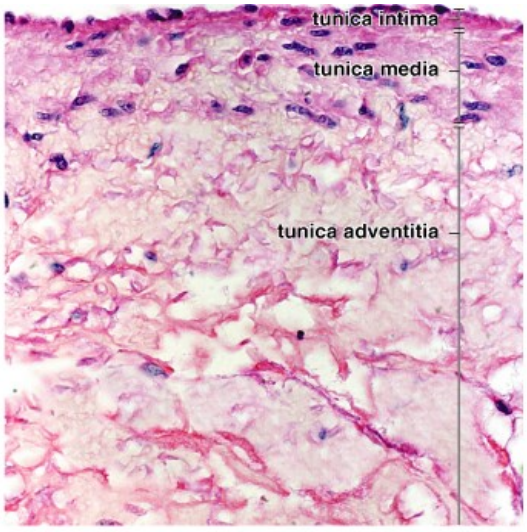


Figure 12.15. **Photomicrograph of the wall of medium-sized vein.** X360.

Large v.s

-Includes the supra & infra Vena cava & their main tributaries.

- **T I**: same as medium sized v., it may be thicker.(Well developed)

- **TM**: is relatively thin with few layers of smooth muscle & abundant c.t.

- **TA**: thickest composed of longitudinal bundles smooth muscle & collagen & elastic fibers.

Blood vessel of blood vessel (Vasa vasorum)

- Large vessels (a.s &v.s) of diameter over 1 mm are supplied by small, nutrient BV that is called **Vasa vasorum** which means **vessels of the vessel** & in veins more than arteries.

The heart

It is a muscular, highly specialized portion of the vascular system.

It consists of 4 chambers:

RT & LT atria

RT & LT ventricles

The heart wall consists of 3 layers

1- Endocardium (inner layer).

2- Myocardium (middle layer).

3- Epicardium (outer layer).

Endocardium

-It lines all internal surfaces of the heart.

- It has three layers; endothelium, Subendothelium and Subendocardial layer: which is composed of CT that contains.

Myocardium Composed of cardiac muscle cells that run in different directions

Epicardium: It is the visceral pericardium, covered externally by a single layer of simple sq. epith. (mesothelium), which is supported by very thin layer of CT containing elastic fibers.

-Subepicardial layer: composed of loose CT

Impulse-conducting system

Include:

1- Sino-atrial node

2- Atrio-ventricular node

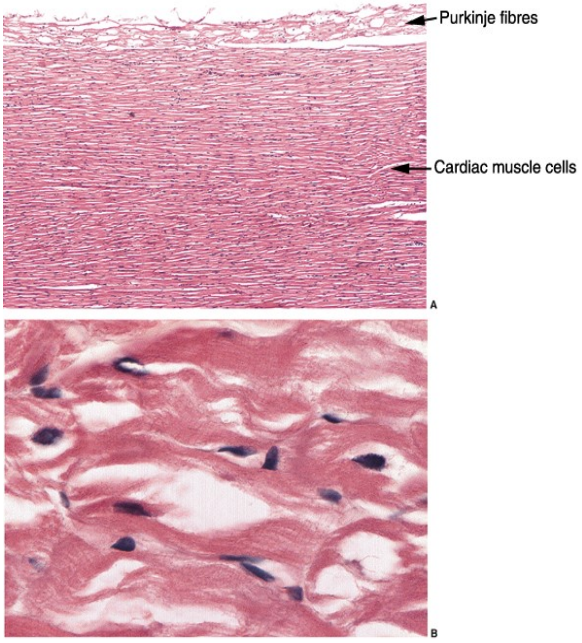
3- Bundle of His

4- Right & left bundle branches

5- Purkinje fibers

Purkinje fibers : They are modified cardiac muscle fibers. They conduct impulses faster than the ordinary heart muscle fibers.

Histological features of purkinje fibers:



-Light microscopically (LM) features:

purkinje fibers resemble ordinary cardiac muscle in that:

1- They have central nuclei
2- They have cross striation.

However they differ from them in that:

1- They are generally larger & paler
2- They have more sarcoplasm.
3- Their nuclei are surrounded by clear perinuclear area.

-Electron microscopically (EM) features:

Ultra structurally Purkinje fibers have the following features:

1- They contain large amount of glycogen.
2- They contain less amount of myofibrils which tend to lie peripherally(this explain the presence of clear perinuclear area)
3- Sarcoplasm reticulum is not well developed as in cardiac muscle cells.